



# ESDIS Standards Office Status Update

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# What is the ESO?

- Former ESDSWG Standards Process Group is now the ESDIS Standards Office
  - ***SPG endorsed data format standards are Level 1 requirements for new NASA missions*** – ESO will maintain and update that list
  - Incorporated into ESDIS for closer ties to NASA Earth Science Data System goals
  - Continuity of staffing to retain corporate knowledge
- Activities since last ESDSWG
  - Reviewed ESDSWG Standards Process and implemented process improvements
  - Updated web presence for better presentation of standards and practices to the community
  - Leading review of MENDS ECHO-ISO mappings



# Standards Process Review

## Goals

- Clarify and improve standards process inherited from ESDSWG Standards Process Group; simplify where possible
- New approach for developing and emerging standards

## Review Group Members

- Evelyn Ho
- Matt Cechini
- Amanda Leon
- Rahul Ramachandran
- ESO staff (Yonsook, Helen, Allan)
- ESDIS (Andy Mitchell, Jeff Walter)
- ESDSWG Liaison (Steve Olding)



# Document Categories

## Types of Documents

- **Standard** - specification approved by a recognized standards body such as OGC, ISO
- **Convention** - specification in common use among some members of the NASA ESDS community
- **Suggested Practice** - guidance on how to apply a particular standard or convention within the NASA ESDS community
- **Lessons Learned** - document describing the use of software, protocols or processes that may be helpful to others

## Describing these Resources

- **Software** - library or toolkit available for use
- **Specification** - document describing a format or protocol in sufficient detail that it can be independently implemented in software
- **Process** - steps that can be followed to reach a desired conclusion
- **Technical Note** - other technical document of interest to the community

For these types of **Technologies** (list can grow as needed)

- **Data Format**
- **Metadata**
- **Discovery / Access**



# Document Status

## Review Status

- **Legacy** - formal review has been bypassed for a legacy standard in common usage
- **Monitoring** - up and coming technology to watch
- **In development**
- **Submitted**
- **In review**
- **Final**

## Recommendation

- **Required** – probably very few standards would be required for all ESDIS systems
- **Recommended**
- **Approved** – OK to use, but similar "recommended" technology would be preferable
- **Emerging** – promising technology, not rigorously reviewed or widely adopted yet
- **Limited** – for use in certain circumstances
- **Deprecated** – don't choose for new projects
- **Obsoleted** – no longer in use
- **Proposed** – for documents still in the review process



# Simplified Process

## Phase 1 Document Submission

- Develop idea for standard
- Contact ESO for initial consultation
- Write the document (with handy template)
- Gather names of people/groups who are using the spec
- Submit to ESO

## Phase 2 Document Editing

- ESO reviews document, helps submitters with formatting, etc.
- ESO forms a TWG (Technical Working Group) to review the document
- TWG reviews the document for completeness, provides feedback, helps submitters complete any final edits

## Phase 3 Community Review

- TWG decides on review strategy (depends on kind of document)
- TWG develops review questions
- TWG sends questions to as many reviewers as possible
- TWG collects & analyzes results
- TWG makes a recommendation to ESDIS whether to adopt the document as a standard, convention, etc. or not.



# Web Presence: Standards List – before & after

## Data Format Standards

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The following table lists data formats that have been approved for use and officially endorsed by the NASA Earth Science Division (ESD) for use in Earth science data systems. The full list of NASA ESD approved standards and technical notes, as well as information on the standards submission and approval process, is available on the Standards Process Group (SPG) page.

ESDS-RFC	Title	Revision	Class	Status	Errata
ESDS-RFC-007	HDF 5	1	Standard	Final	None
ESDS-RFC-008	HDF EOS 5	1	Standard	Final	None
ESDS-RFC-009	Aura File Format Guidelines Technical Note	1	Technical Note	Final	None
ESDS-RFC-011	NetCDF Classic	1	Standard	Final	None
ESDS-RFC-017	Mapping HDF5 to DAP2	1	Technical Note	Final	None
ESDS-RFC-018	Creating File Format Guidelines: The Aura Experience	1	Technical Note	Final	None
ESDS-RFC-019	International Consortium for Atmospheric Research on Transport and Transformation (ICARTT) File Format Standards	1	Standard	Final	None
ESDS-RFC-022	NetCDF-4/HDF5 File Format	1	Standard	Final	None
ESDS-RFC-026	OGC KML	1	Standard	Final	None

The following table lists data formats that are approved for use in Earth science data systems by the NASA Earth Science Data and Information Systems (ESDIS) Project but have not been officially endorsed by the NASA Earth Science Division (ESD).

Type	Title
NASA SPG Heritage Standard	GeoTIFF

### Data Formats

#### HDF

##### NASA ESD-approved Standards

- ESDS-RFC-007 HDF 5
- ESDS-RFC-022 NetCDF-4/HDF5 File Format

##### NASA ESD Technical Note

- ESDS-RFC-017 Mapping HDF5 to DAP2

The Hierarchical Data Format (HDF) is designed to facilitate managing and sharing scientific data. HDF includes two formats (HDF4 and HDF5), software for accessing data in HDF formats, and applications for working with HDF data. HDF is designed for efficient storage and access of high volume, complex data, and for mixing varieties of data types in a single container. HDF libraries are used to read and write data, to define data types and structures for applications, and to control how data is stored.

## Standards List

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### Data Format Standards

- HDF 5
- HDF EOS 5
- NetCDF Classic
- International Consortium for Atmospheric Research on Transport and Transformation (ICARTT)
- NetCDF-4/HDF5 File Format
- Guidelines for a Common File Format for Aura Instruments
- Creating File Format Guidelines: The Aura Experience
- Mapping HDF5 to DAP2
- OGC KML

### Metadata Standards

- GCMD Directory Interchange Format (DIF)
- NetCDF Climate and Forecast (CF) Metadata Conventions
- Interoperability between OGC CS/W and WCS Protocols
- ECHO Metadata Standard
- Updates to GCMD Directory Interchange Format (DIF)

### Discovery and Access Technologies

- The Data Access Protocol - DAP 2.0
- OpenGIS ® Web Map Service Version 1.1.1
- OpenGIS ® Web Map Service Version 1.3
- Backtrack Orbit Search Algorithm
- Lessons Learned Regarding WCS Server Design and Implementation

### In Progress

- GCMD Service Entry Resource Format (SERF)
- Provenance within Data Interoperability Standards

<https://earthdata.nasa.gov/data/standards-and-references>



# Web Presence: Document Page – before & after

## ESDS-RFC-022

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Title  
netCDF-4/HDF5 File Format

Abstract

This document nominates the netCDF-4/HDF5 File Format for adoption as a NASA ESDS community standard. It specifies the netCDF-4/HDF5 file format independent of the netCDF I/O libraries designed to read and write netCDF-4/HDF5 data. The netCDF-4/HDF5 file format enables the expansion of the netCDF model, libraries, and machine-independent data format for geoscience data. Together the netCDF interfaces, libraries, and formats support the creation, access, and sharing of scientific data.

With suitable community conventions, the netCDF-4/HDF5 data format can help improve the capability to read and share important scientific data among data providers, data users, and data services.

Synopsis

RFC	ESDS-RFC-022
Title	netCDF-4/HDF5 File Format
Revision	1
Class	Standard
Status	Final
Errata	None
Files	ESDS-RFC-022 v1 (.pdf)
Archive	<a href="https://earthdata.nasa.gov/library/esds-rfc-022">https://earthdata.nasa.gov/library/esds-rfc-022</a>
Older Versions	None
Contact	<a href="mailto:spg-rfc-comment@lists.nasa.gov">spg-rfc-comment@lists.nasa.gov</a>
Additional Files	None
Final Recommendation	Final Recommendation

Final Recommendation

The ESDS-RFC-022 Technical Working Group (TWG) has conducted a review of ESDS-RFC-022 – "netCDF-4/HDF5 File Format" and reached the following conclusion:

*That the Standards Process Group should forward ESDS-RFC-022 to NASA Earth Science Division with the recommendation that it be endorsed as a NASA Standard.*

Recommendation

The TWG bases its recommendation on positive comments from the Earth Science community, including users from NASA, NOAA and academia, and an analysis of the following factors in a NASA context:

**Strengths** – netCDF-4 is straightforward to use relative to HDF5, with a lower learning curve. The many tools available enhance ease of use. Use of the HDF5 storage layer in netCDF-4 software provides features for improved performance, such as compression, parallel

## netCDF-4/HDF5 File Format

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Summary

This document nominates the netCDF-4/HDF5 File Format for adoption as a NASA ESDS community standard. It specifies the netCDF-4/HDF5 file format independent of the netCDF I/O libraries designed to read and write netCDF-4/HDF5 data. The netCDF-4/HDF5 file format enables the expansion of the netCDF model, libraries, and machine-independent data format for geoscience data. Together the netCDF interfaces, libraries, and formats support the creation, access, and sharing of scientific data.

With suitable community conventions, the netCDF-4/HDF5 data format can help improve the capability to read and share important scientific data among data providers, data users, and data services.

Status

The netCDF-4/HDF5 File Format was **recommended** for use in NASA Earth Science Data Systems in March 2011.

Specification Document	netCDF-4/HDF5 File Format
User Resources	Appendix B of the spec document provides guidelines that will enable HDF5 users to create files that will be accessible from netCDF-4.  <a href="#">netCDF Project Web Site</a>
Standards Body	Open Geospatial Consortium (OGC)

NASA Earth Science Community Recommendations for Use

Strengths

netCDF-4 is straightforward to use relative to HDF5, with a lower learning curve. The many tools available enhance ease of use. Use of the HDF5 storage layer in netCDF-4 software provides features for improved performance, such as compression, parallel I/O, relaxed size limits, and the performance benefits of chunking and endianness control.

Weaknesses

Installation and set-up could be improved. HDF5 users point out that more manual intervention is required for installing netCDF-4/HDF5 than for HDF5 alone. NetCDF users point out that for netCDF-4, multiple software libraries must be installed (netCDF, HDF5, possibly other supporting libraries), rather than the one software library required for netCDF-3.

Applicability

netCDF-4 handles many data types and structures needed for Earth science. Those already using HDF tools can access netCDF-4 data using the HDF-5 API rather than netCDF. Those who have not been using HDF tools welcome access to much of the power of HDF via the simpler netCDF API. Community reviewers of the RFC cite many terabytes of data in netCDF-4, with thousands of users.

Limitations

One reviewer noted some internal inconsistencies between the netCDF-4 specification and the DAP library implementation. A more significant issue is that support for Windows users lags significantly behind Linux. This appears to be a problem for both the HDF5 and netCDF-4 software libraries.

Tags:  
ESO  
standard  
data format  
Final  
specification  
recommended



# New ESO Documents

- Newly approved standard
  - OGC KML
- Documents under review
  - Datacasting – need new lead author; identify active user community
  - ESIP OpenSearch Conventions
    - Doug Newman taking over from Chris Lynnes as the lead author for the edits based on community comments
    - Extensive coordination with OGC's OpenSearch standard review process
- Documents under development
  - GeoTIFF – original spec to be updated by Ted Habermann & HDF Group for submission as a proposed ESDIS standard



# Background for Developing Standards

- ESO reviews an existing convention or standard to
  - evaluate the technical value of the specification,
  - determine its fitness for the purpose,
  - confirm that working implementations exist.
- *Funded mission data systems can use the ESDS recommended standards with high confidence that the specification is accurate and works with NASA data in NASA environments.*
- ESDIS project also needs to support developing and emerging standards to fulfill current and future needs of the NASA Earth science data systems.



# Developing/Emerging Standards

- For developing standards, different kinds of reviews are needed:
  - Provide constructive feedback to the authors of the new specification in interim points in order to improve the quality and fitness for purpose of the developing standard
  - Evaluate developing standards (even before complete documentation is written) through evaluating a prototype of its capabilities
- The testbed/prototype approach can also be used with emerging standards.
  - Emerging standards often do not have a community of users who can review and comment on the specification.
  - Evaluating a prototype of an emerging standard can provide constructive feedback to the authors and also help provide visibility to the broader NASA Earth science systems community.
- The type of prototype evaluation will need to be tailored to the specific developing/emerging standard



# Case Example: MENDS III Evaluation

- The MENDS (Metadata Evolution for NASA Data Systems) III team completed the much of the mapping of the ECHO metadata that gets returned on searches to ISO 19115 metadata.
  - Metadata mapping is documented in intro documents, spreadsheets of crosswalks from ECHO metadata to ISO, XML fragments, etc.
  - Extended MENDS team has reviewed all the documents as they were written. But is the document review enough in this case?
- ESO is supporting the MENDS III evaluation by asking reviewers to exercise the Reverb/ECHO searches for data collections they have science knowledge of. Testers are asked to view the metadata search results in both ECHO-10 and ISO 19115 to confirm that the mappings work in practice.



# ESO Interactions!

*Poster session tonight:* Come to the ESO corner and talk to us about standards you are using or developing, and standards and best practices that you are interested in!

*Standards Interest Group:* We will be conducting special topics telecons about technology areas of interest, new and emerging standards, etc. Come and tell us what topics are of interest to you! Join the eso-sig email list.

*Summer ESIP ESO Session:* We will be soliciting information about what testbeds you have in your organization, ideas for leveraging different testbeds for reviewing developing/emerging standards,...



# How To Get Involved



**WE WANT YOU!**

Volunteer to help review proposed standards

Volunteer to help provide feedback on developing and emerging standards

Submit best practices, lessons learned, and specifications for ESO review and endorsement